Durham E-Theses

The structure and evolution of the Wessex Basin.

Lake, S.D.

How to cite:

Lake, S.D. (1985) *The structure and evolution of the Wessex Basin.*, Durham theses, Durham University. Available at Durham E-Theses Online: http://etheses.dur.ac.uk/1215/

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a link is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the full Durham E-Theses policy for further details.

Academic Support Office, Durham University, University Office, Old Elvet, Durham DH1 3HP
e-mail: e-theses.admin@dur.ac.uk Tel: +44 0191 334 6107
http://etheses.dur.ac.uk

THE STRUCTURE AND EVOLUTION OF THE WESSEX BASIN

by

STUART DAVID LAKE B.Sc.

VOL II

A thesis submitted to the University of Durham
for the degree of Doctor of Philosophy.

The copyright of this thesis rests with the author. No quotation from it should be published without his prior written consent and information derived from it should be acknowledged.

Department of Geological Sciences, December 1985.

15. APR. 1986

SS ST 0

ST SU 0

western Wessex Basin
solid geology
1:250,000

N

TERTIARY FORMATIONS
CRETACEOUS FORMATIONS
JURASSIC FORMATIONS
TRIASSIC FORMATIONS
PERMIAN FORMATIONS
PRE-PERMIAN FORMATIONS
PERMIAN VOLCANICS
T OFFSHORE TERTIARY
C OFFSHORE CRETACEOUS
J OFFSHORE JURASSIC
PT OFFSHORE PERMO/TRIAS

S.D.LAKE 1985

KEY

Map excludes isolated Mesozoic outcrops in S.Wales and Bristol Channel.

Faults
Lithological boundary
Syncline
Anticline
Alluvium

0 5 10 15 20 25 Km
0 5 10 15 M
SCALE

SS SX 0

SU SZ 0

4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

SX SY

SY SZ

NORTH

COOLES FARM

DEVIZES

BRUTON (10Km to west)

WINTERBORNE KINGSTON

WYTCH FARM

ARRETON (50Km to east)

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

5

10

15

20

25

30

35

40

KEY

Basin infill
- TERTIARY SEDIMENTS
- CRETACEOUS SEDIMENTS
- JURASSIC SEDIMENTS
- PERMO-TRIAS SEDIMENTS

UPPER CARBONIFEROUS TO PROTEROZOIC VOLCANICS AND SEDS

OLDER PRECAMBRIAN BASEMENT

MOHO (Max and Min depth)

FAULT

BOREHOLE CONTROL

Durham University N.E.R.C

SCALE

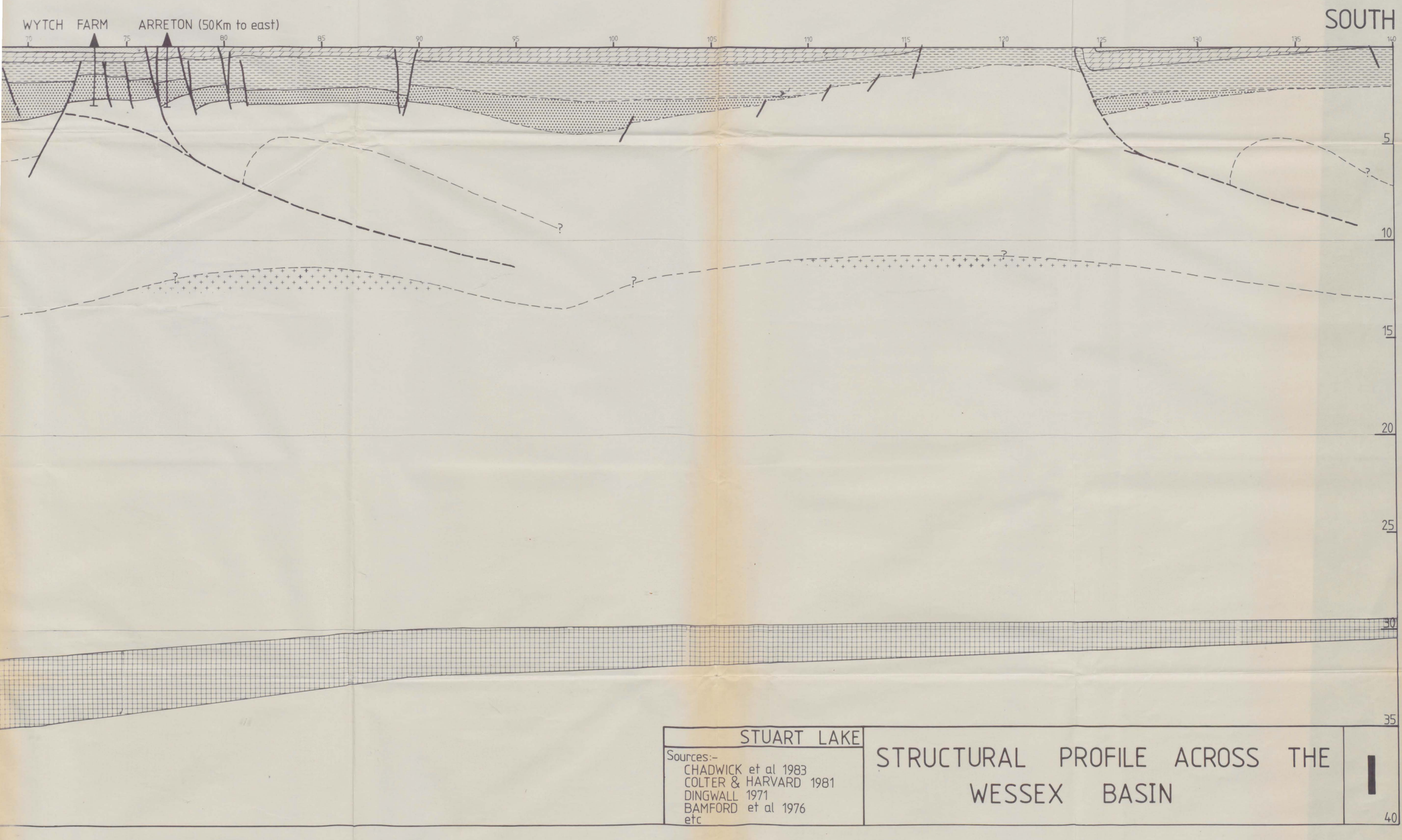
1:100,000

0 1 2 3 4 5 6 7 8 9 10 kms

miles 0 1 2 3 4 5 6

No Verticle Exaggeration

11.2.1



STUART LAKE

Sources:-
CHADWICK et al 1983
COLTER & HARVARD 1981
DINGWALL 1971
BAMFORD et al 1976
etc

STRUCTURAL PROFILE ACROSS THE WESSEX BASIN

I

003 00W

002 00W

001 00W

50 00N

EC 69

EC 71

EC 73

EC 55

EC 61

IGS DEN 58

EC 67

EC 2

EC 4

EC 6

EC 8

EC 10

EC 12

EC 14

EC 16

EC 18

EC 20

EC 22

EC 24

EC 28

EC 30

EC 32

EC 34

EC 36

EC 40

EC 42

EC 44

EC 48

EC 50

EC 54

EC 56

EC 62

EC 64

EC 70

EC 82

EC 88

EC 63

IGS 77-21

IGS 77-07

GSI 93

GSI 85

GSI 69

GSI 41

EC 49

EC 68

EC 72

GSI 2004

EC 80

GSI 2002

GSI 1033

GSI 21

GSI 17

Scale
1:250,000

0 5 10 15 20 25 30

0 5 10 15

11.2.2.

001 00W

000 00E

001 00E

50 00N

EC 5

EC 23A

EC 144

EC 27

GSI 21

GSI 17

GSI 13

GSI 13

GSI 63

GSI 69

EC 13

EC 15

EC 33

EC 35

EC 120

EC 128

EC 39

EC 106

EC 98

EC 88

EC 82

EC 70

EC 64

EC 62

EC 68

EC 72

GSI 2004

EC 80

GSI 2002

GSI 1003

EC & GSI = GSI survey

IGS DEN & IGS = IGS

Track lines of seismic reflection profiles

based on GSI non exclusive seismic r. survey and IGS projects 76/8 and 77/1 (part)

Scale
1:250,000

0 5 10 15 20 25 30 35 40 45 50 Kilometers

0 5 10 15 20 25 Miles

© STUART LAKE
1985 DURHAM UNIVERSITY

003 36W
003 24W
003 12W
003 00W
002 48W
002 36W
002 24W
002 12W
002 00W
001 48W
001 36W
001 24W
001 12W
001 00W
000 36W
000 24W
000 12W

51 00N
50 50N
50 40N
50 30N
50 20N
50 10N
50 00N
49 50N
49 40N
49 30N

Scale
1:250,000

0 5 10 15 20 25 30 35 40 45 50 Kilometers
0 5 10 15 20 25 Miles

001 12W | 001 00W | 001 00W | 000 36W | 000 24W | 000 12W | 000 00E | 000 12E | 000 24E | 000 36E | 000 48E | 001 00E | 001 12E | 001 24E | 001 36E | 001 48E

50 00N

Top Penarth group structural map English Channel

INTERPRETATION BY S.D.LAKE

based on G.S.I non-exclusive seismic survey

KEY

- Reverse faults
- >50 Millisecs throw (TWT)
- <50 Millisecs throw (TWT)
- Isochrons (100 Millisec intervals)
- Outcrop of Penarth Group
- Faults
- Anticlines
- Synclines

Surface exposure (Geological maps)

- Anticlines
- Synclines

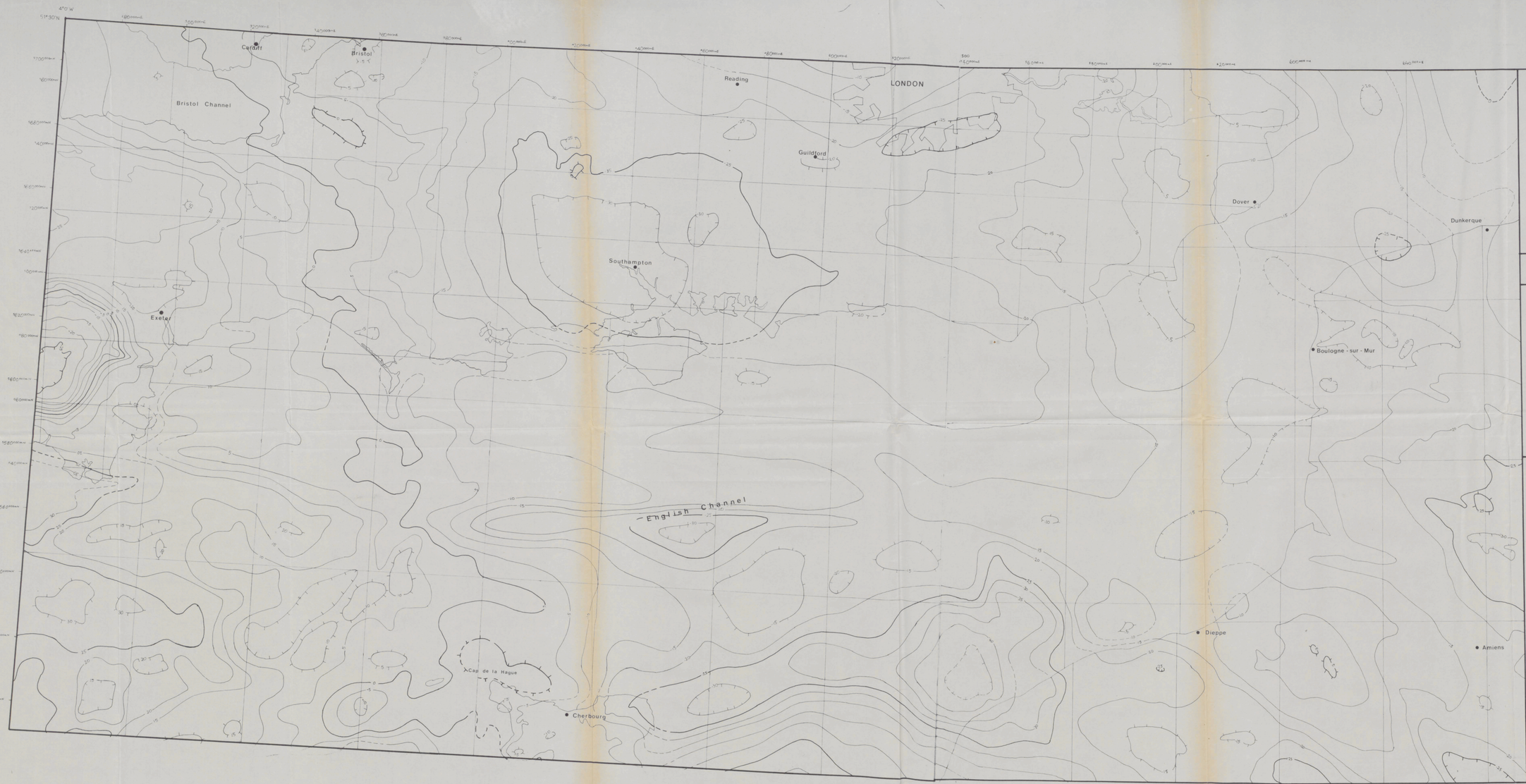
Penarth.G.

Scale
1:250,000

0 5 10 15 20 25 30 35 40 45 50 Kilometers
0 5 10 15 20 25 Miles

© STUART LAKE
1985 DURHAM UNIVERSITY

000 00E



COMPOSITE BOUGUER GRAVITY ANOMALY MAP, WESSEX BASIN

1:500,000

REDRAWN FROM B.G.S SOURCES

KEY

ISOGAL VALUES IN MILLIGAL LINES AT 5mGal INTERVALS

ANOMALY HIGH

ANOMALY LOW

SOURCES

U.K DATA

IGS 1:250,000 BOUGUER GRAVITY

ADDITIONAL UNPUBLISHED DATA

FRENCH DATA

B R G M 1:80,000 CARTES GRAVIMÉTRIQUES DE LA FRANCE

International Gravity Formula 1967 -5mGal applied to B.R.G.M data to convert to I.G.F 1967 and NGRN 1973

0 10 20 30 40 50 Km

0 10 20 30 M

SCALE

11.25.

3°30W 3°00W 2°30W

50°40N 50°30N 50°20N 50°10N 50°00N

1·4
(3550m) 1·6
1·8
2·0
(5047m) 2·2
2·4
2·6
(6890m) →
← (4090m)
1·6
1·8 (4000m)
2·0
2·2
2·4 (5890m)
2·6
2·8
2·8
3·0
?
?
(3840m) 1·8
2·0
2·2
2·4
2·6
(3300m) 1·6
1·8
2·0
2·2
(4367m)
2·2
2·4 (5740m)
2·6
2·8
3·0
2·8
2·6
2·4
2·2
2·0

REFLECTORS (IN SECONDS)

R1
R2
R3
R4
R5
R6

G.S.I NON EXCLUSIVE SEISMIC LINES

R1 RELATED STRUCTURES
R2 RELATED STRUCTURES
R6 RELATED STRUCTURES
'FLAT' PORTION OF REFLECTOR

KM
0 5 10 15 20 25
0 5 10 15
M
Scale

11.31.

PRE APTIAN SUBCROP MAP

- LITHOLOGICAL BOUNDARIES
- WESTWARD EROSIONAL LIMIT OF LOWER GREENSAND
- WESTWARD LIMIT OF GAULT
- FAULTS

H1	WEALDEN
G14	PURBECK
G13	PORTLAND
G12	KIMMERIDGE CLAY
G9-11	CORNBRASH TO CORALLIAN
G5-8	INFERIOR OOLITE TO FOREST MARBLE
G1-4	LOWER JURASSIC
F	TRIASSIC
E	PERMIAN
B	BASEMENT

LAKE 1985

Unconformity

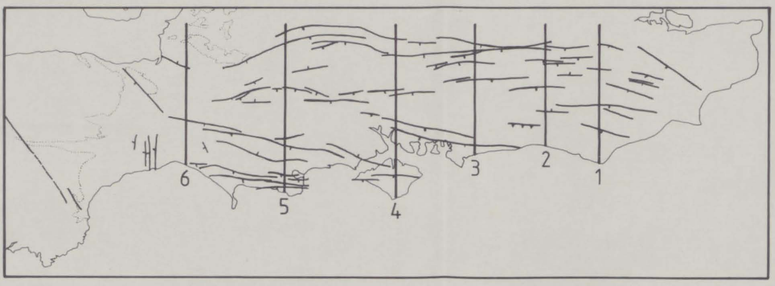
Grid N

0 5 10 15 20 25 30 35 40 45 50 Km

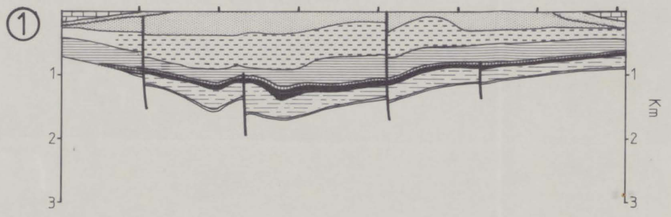
5 10 15 20 25 30 M

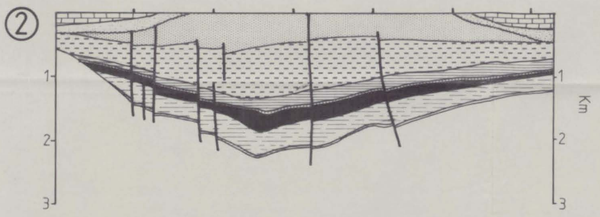
Scale

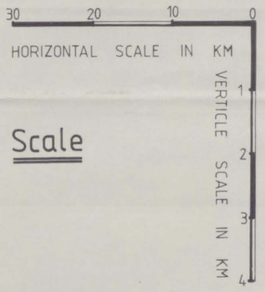
SS SX SU SZ SX SY SY SZ



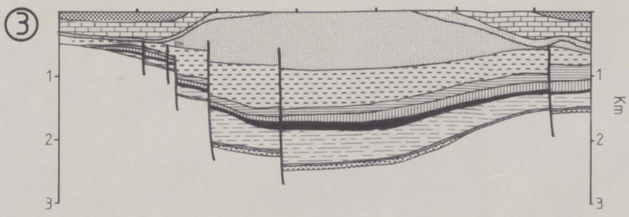
North South

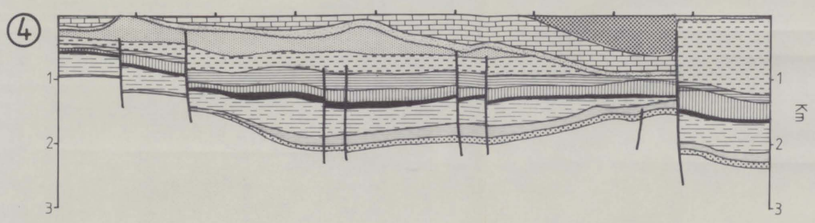


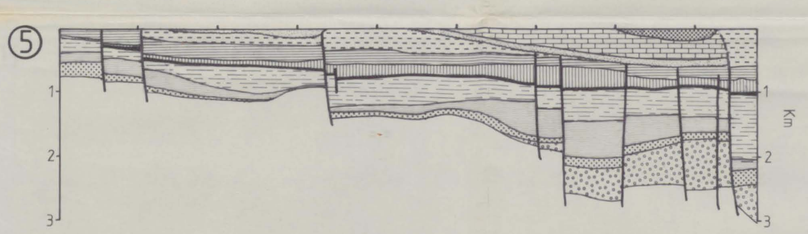


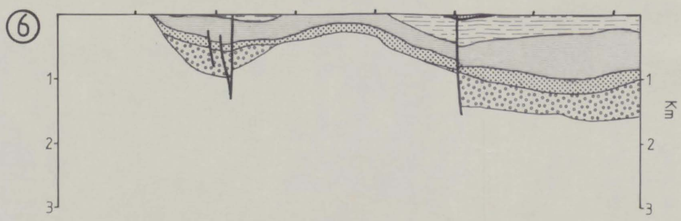


Scale









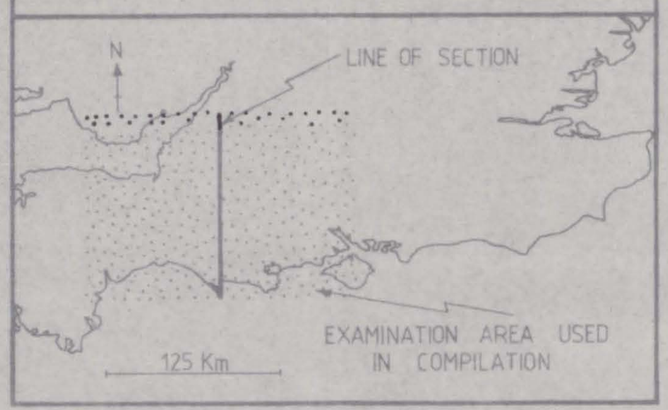
KEY

- TERTIARY FORMATIONS
- CHALK
- UPPER GREENSAND, GAULT, LOWER GREENSAND
- WEALDEN, PURBECK
- PORTLAND, KIMMERIDGE, CORALLIAN
- CORALLIAN (part), OXFORD CLAY, KELLAWAYS
- GREAT OOLITE GROUP
- INFERIOR OOLITE
- LIAS
- PENARTH GROUP, MERCIA MUDSTONE GROUP
- SHERWOOD SANDSTONE GROUP
- PERMIAN

CHRONO - LITHOSTRATIGRAPHIC COLUMN

western Wessex Basin, S. ENGLAND.

(Permian - Quaternary)



KEY

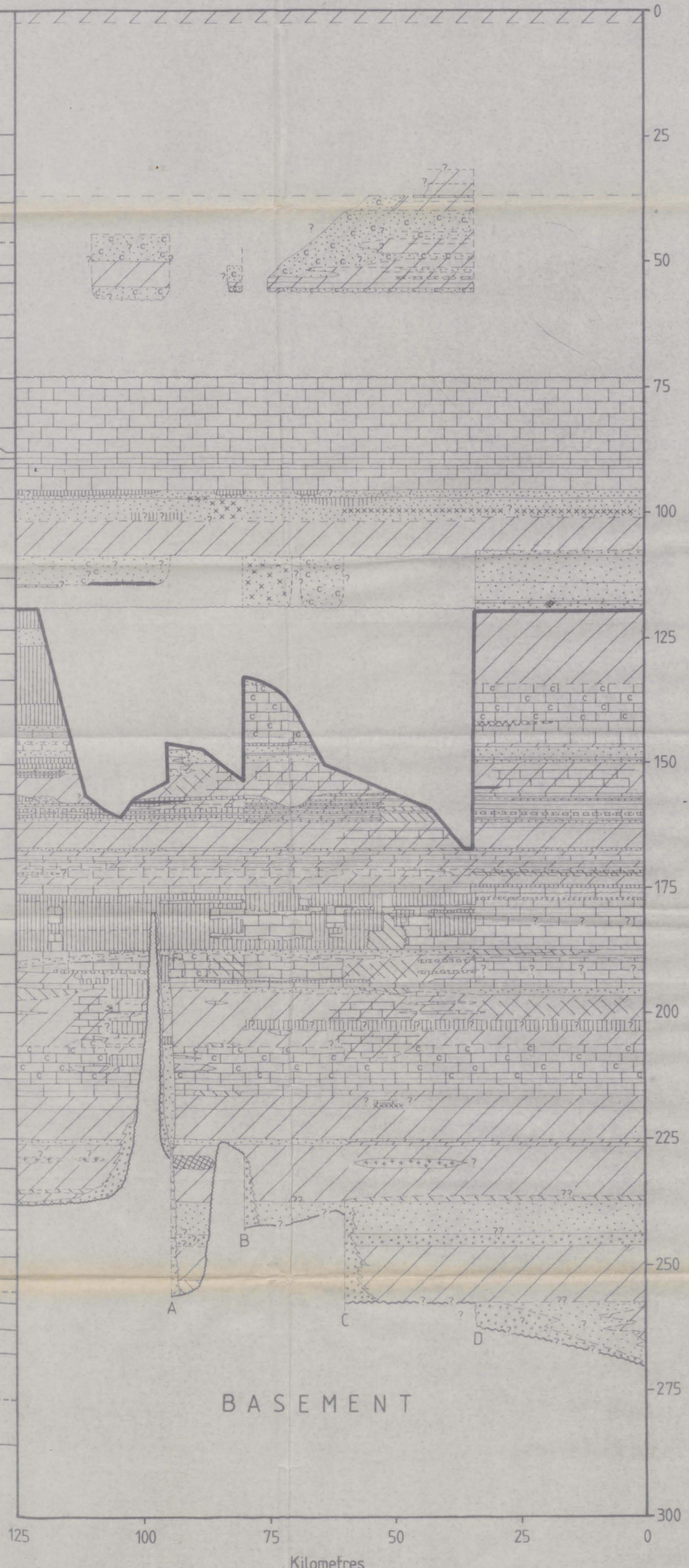
- major growth faults
- Aptian/Albian unconformity
- unconformity

LITHOGRAPHY

- Absent
- mudstone/shale/marl
- sandstone/clay alternating
- limestone
- sandstone
- limestone/clay
- shale predominant - limestone local
- siltstone
- silty mudstone
- non sequence
- silty limestone
- conglomerates & marginal deposits
- halite
- anhydrite
- dolomite
- possibly diachronous boundary
- chert
- iron ore

Tertiary	Neogene		
	Paleogene	Oligocene	
		Eocene	
		Palaeocene	
Cretaceous		Upper	
		Lower	
Jurassic		Upper	
		Middle	
		Lower	
Triassic		Late	
		Middle	
		Early	
Permian		Late	
		Early	

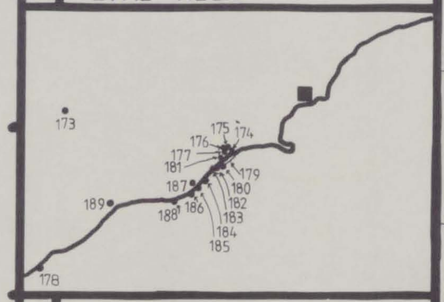
0	
25	Chattian
	Rupelian
	Priabonian
	Bartonian
50	Lutetian
	Ypresian
	Thanetian
	Danian
	Maastrichtian
75	Campanian
	Santonian
	Coniacian
	Turonian
	Cenomanian
100	Albian
	Aptian
	Barremian
125	Hautervian
	Valanginian
	Berriasian
	Tithonian
150	Kimmeridgian
	Oxfordian
	Callovian
	Bathonian
175	Bajocian
	Aalenian
	Toarcian
	Pliensbachian
200	Sinemurian
	Hettangian
	Rhaetian
	Norian
225	Carnian
	Ladinian
	Ansian
	Scythian
250	Tatarian
	Kazanian
	Ufimian
	Kungurian
	Artinskian
275	Sakmerian
	Asselian
300	



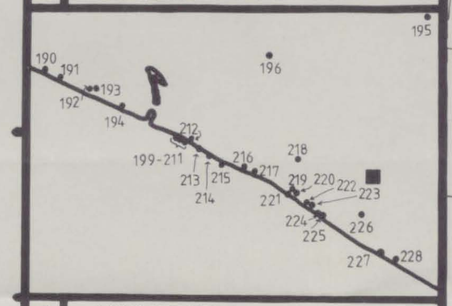
LOCATION MAP

Figure

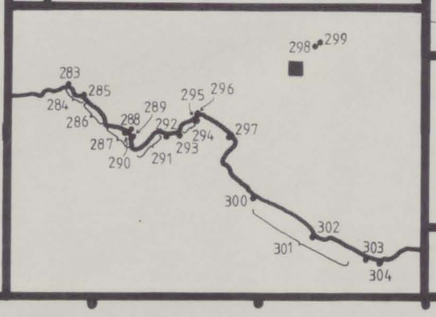
A LYME REGIS



B BURTON BRADSTOCK



C KIMMERIDGE



KEY

•123 Locality number } Locality area

A Areas enlarged to 1:50,000 (see insets)

1:250,000

Weston - super - Mare
Bath
Devizes
Wells
Frome
Warminster
Bridgwater
Taunton
Shaftsbury
Yeovil
Chard
Blandford Forum
Dorchester
Wareham
Weymouth
Poole
Bournemouth
Lymington
Portsmouth
Newport

ST SU

SU SZ

SY SZ

GRID NORTH

0 5 10 15 20 25 30 35 40 45 50 Km
0 5 10 15 20 25 30 M
Scale

11.5.2

ADDITIONAL JURASSIC LOCALITIES

A LYME REGIS

B BURTON BRADSTOCK

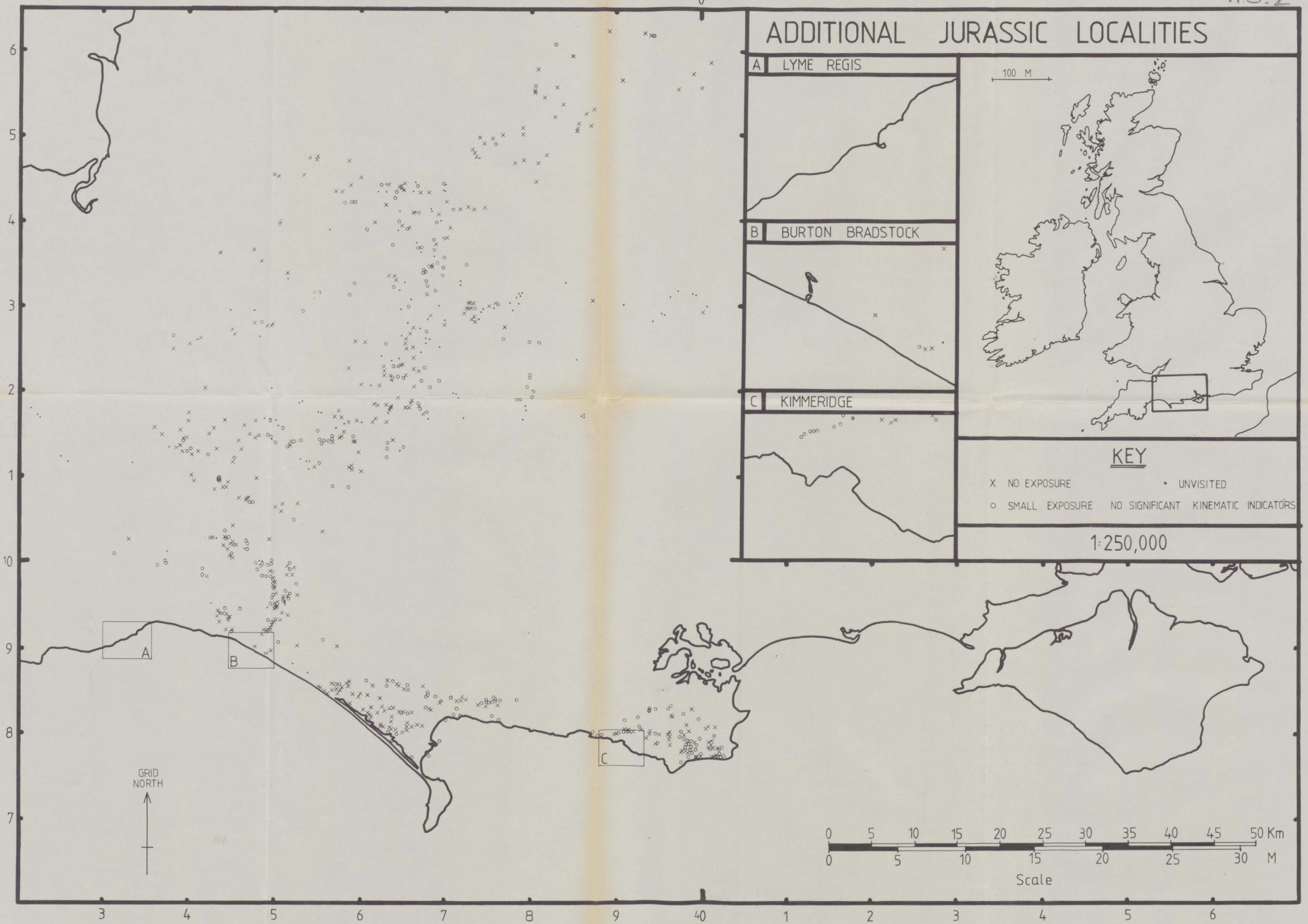
C KIMMERIDGE

KEY

X NO EXPOSURE • UNVISITED

○ SMALL EXPOSURE NO SIGNIFICANT KINEMATIC INDICATORS

1:250,000



0 5 10 15 20 25 30 35 40 45 50 Km

0 5 10 15 20 25 30 M

Scale

11.53

SHEAR SENSE INDICATORS

A LYME REGIS

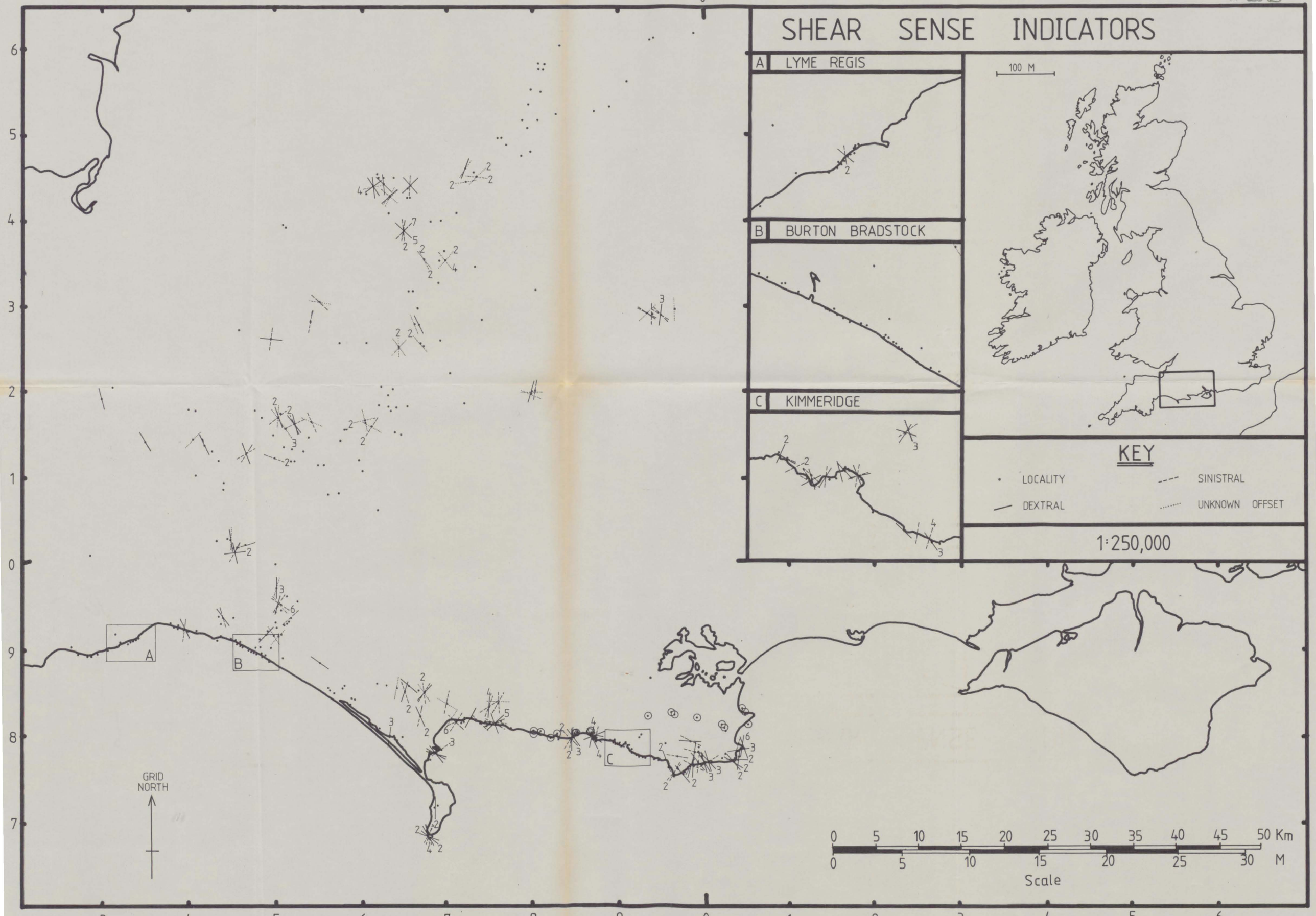
B BURTON BRADSTOCK

C KIMMERIDGE

KEY

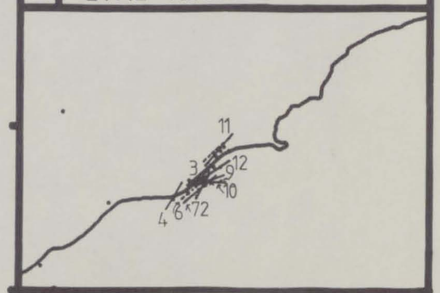
- LOCALITY
- DEXTRAL
- SINISTRAL
- UNKNOWN OFFSET

1:250,000

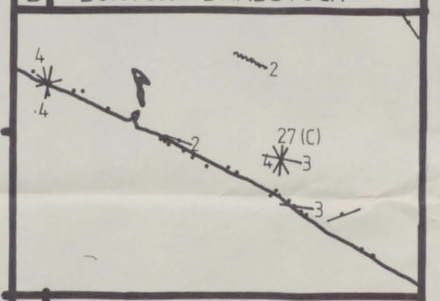


ADDITIONAL KINEMATIC INDICATORS

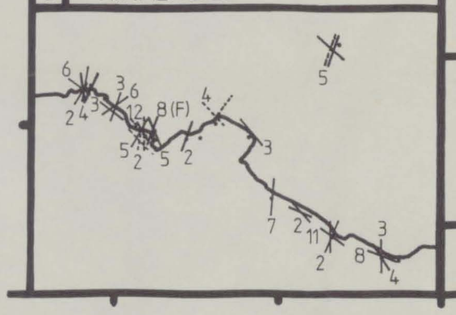
A LYME REGIS

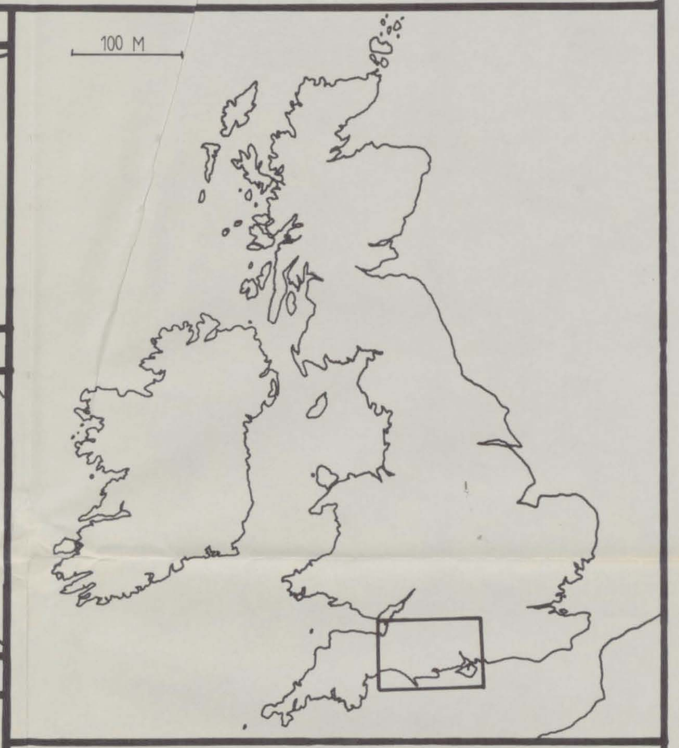


B BURTON BRADSTOCK



C KIMMERIDGE





KEY

- LOCALITY
- CALCITE VIENS
- PYRITE VIENS
- STYOLITE
- (F) FAULT RELATED
- (S) SELENITE COVERED

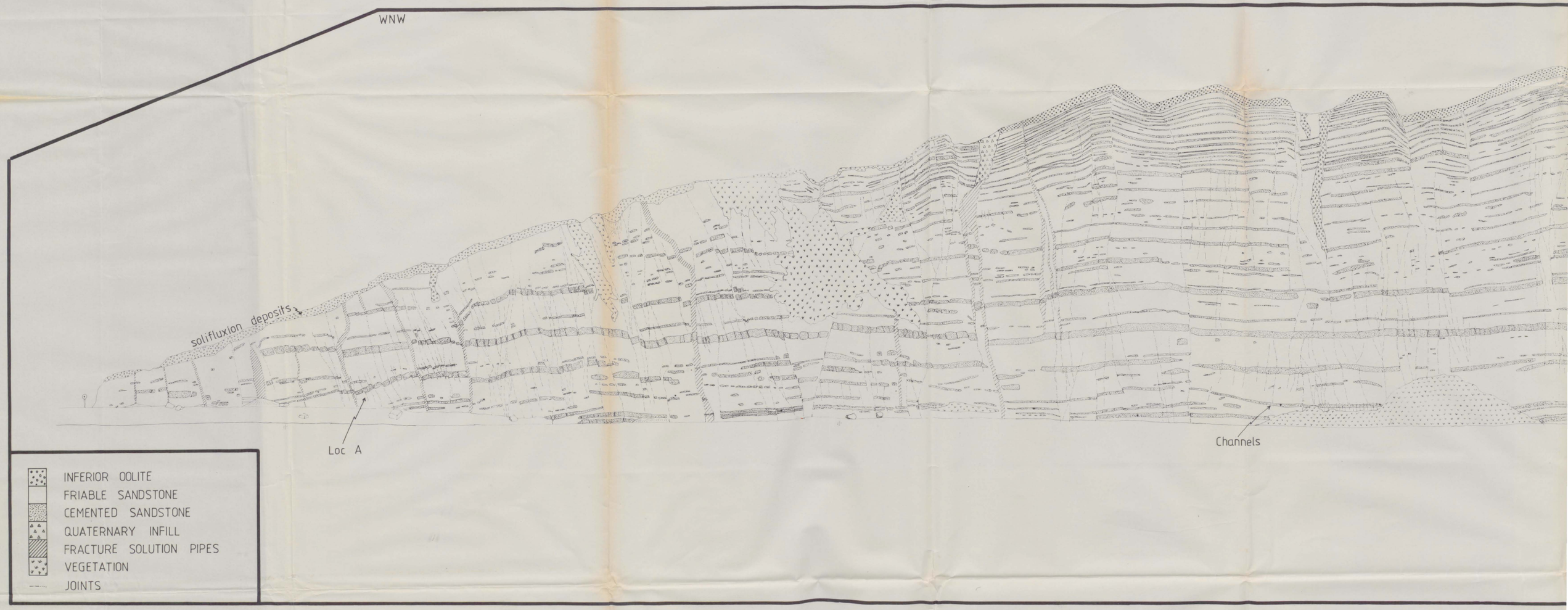
1:250,000

GRID NORTH

0 5 10 15 20 25 30 35 40 45 50 Km

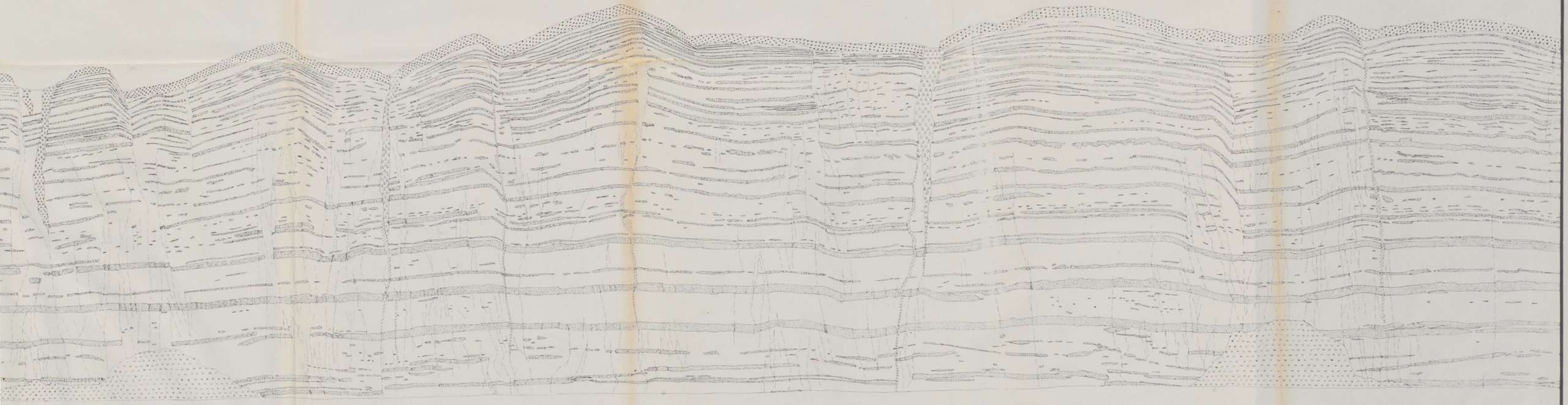
0 5 10 15 20 25 30 M

Scale


WNW
solifluxion deposits
Loc A
Channels
INFERIOR OOLITE
FRIABLE SANDSTONE
CEMENTED SANDSTONE
QUATERNARY INFILL
FRACTURE SOLUTION PIPES
VEGETATION
JOINTS

11.55

ESE



STRUCTURES IN THE BRIDPORT SANDS. EAST CLIFF, BRIDPORT

0 10 20

Metres

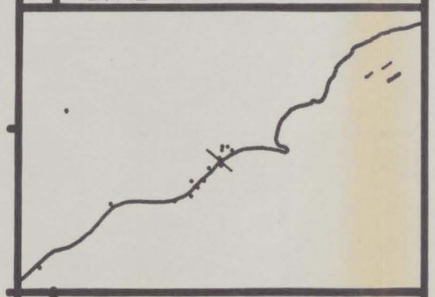
S.D. LAKE

1985

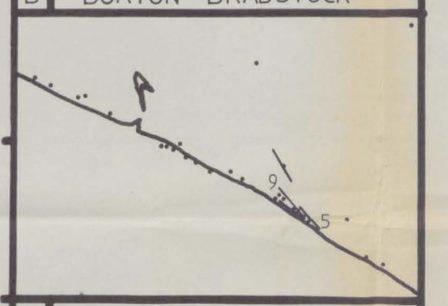
11.56.

PRIMARY JOINTS

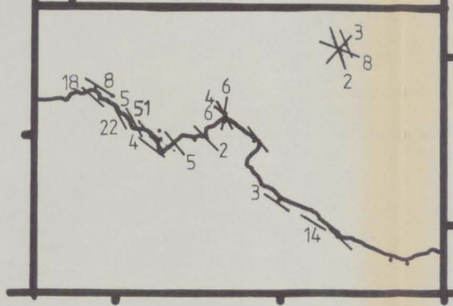
A LYME REGIS



B BURTON BRADSTOCK



C KIMMERIDGE



KEY

• LOCALITY (C) CLAY INFILL

3 JOINT TREND AND NUMBER

1:250,000

GRID NORTH

0 5 10 15 20 25 30 35 40 45 50 Km

0 5 10 15 20 25 30 M

Scale

1157.

SECONDARY AND TERTIARY JOINTS

A LYME REGIS

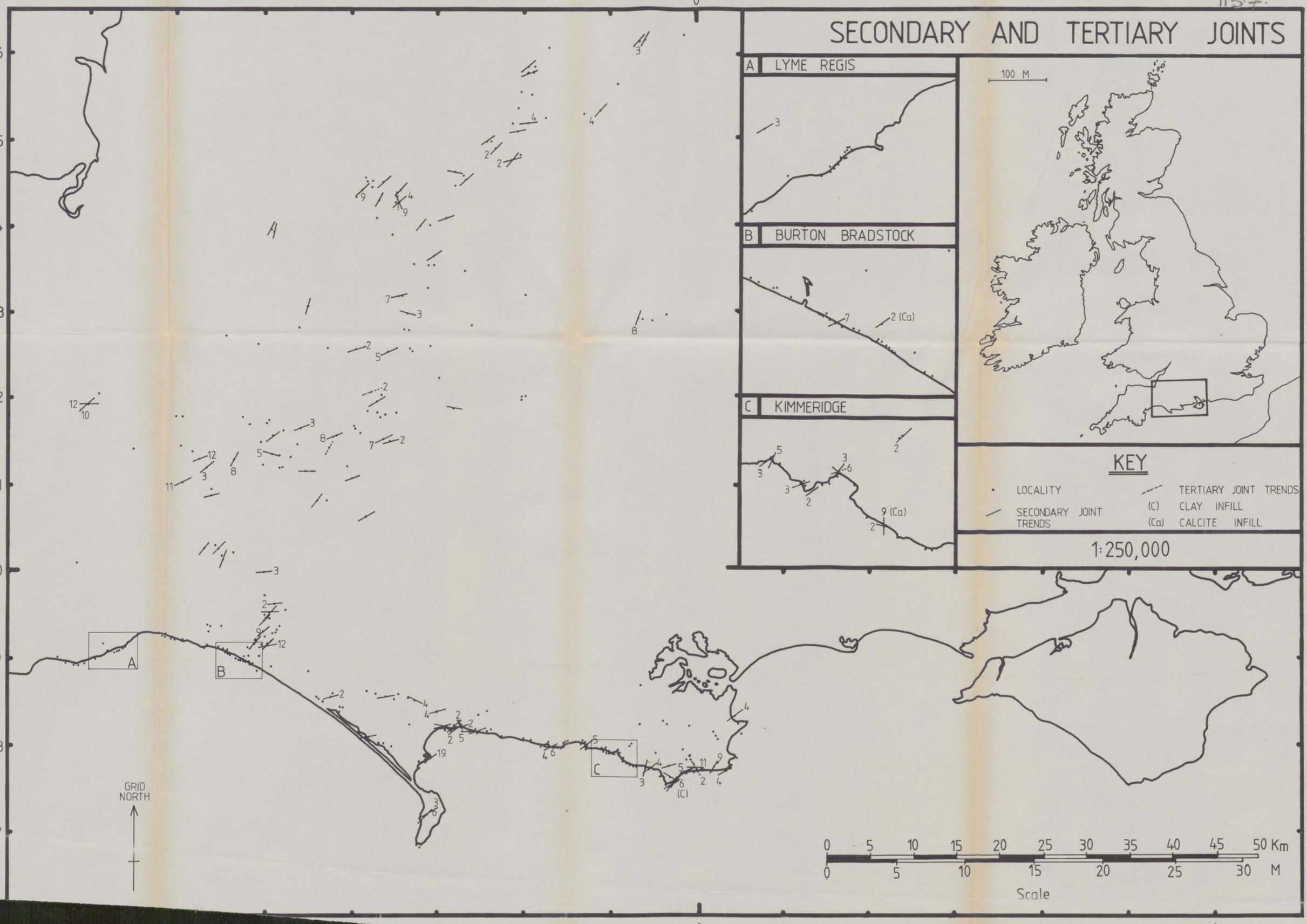
B BURTON BRADSTOCK

C KIMMERIDGE

KEY

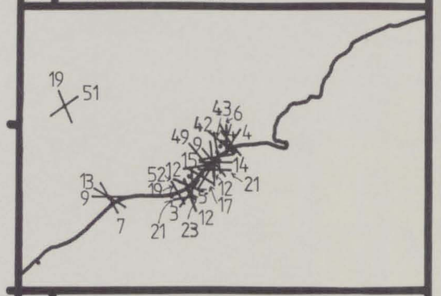
- LOCALITY
- SECONDARY JOINT TRENDS
- TERTIARY JOINT TRENDS
- (C) CLAY INFILL
- (Ca) CALCITE INFILL

1:250,000

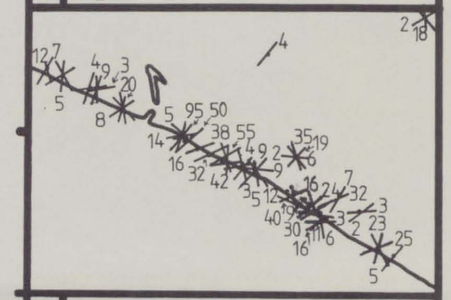


JOINTS ALL ORIENTATIONS UNDEFINED

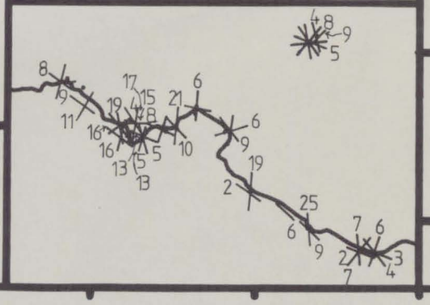
A LYME REGIS

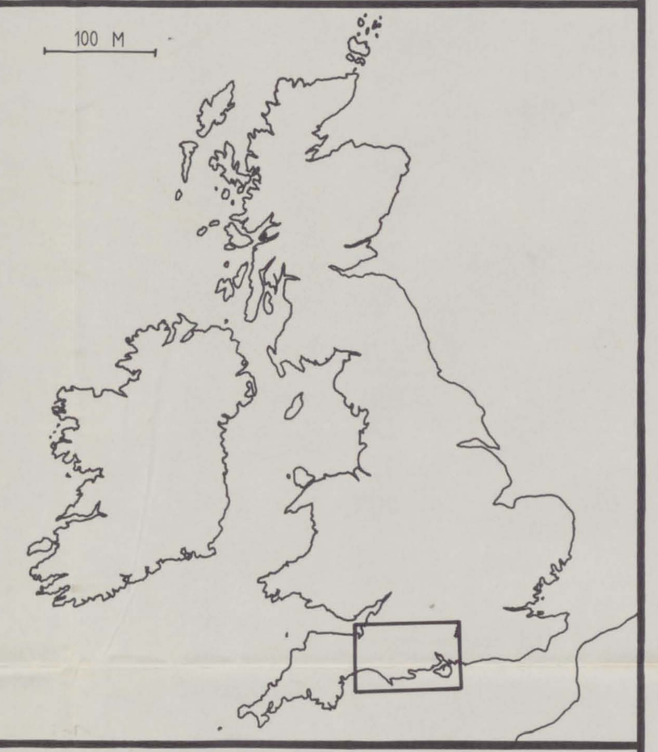


B BURTON BRADSTOCK



C KIMMERIDGE





KEY

- LOCALITY
- JOINT TREND AND NUMBER
- (Ca) CALCITE ON SURFACE
- (F) FISSURES

1:250,000

GRID NORTH

0 5 10 15 20 25 30 35 40 45 50 Km

0 5 10 15 20 25 30 M

Scale

IIA1

BOREHOLES AND WELLS IN THE WESTERN WESSEX BASIN

1:250,000

KEY

- ○ DRYHOLE
- ☼ GEOTHERMAL
- ● OIL WELL
- ■ ABANDONED OIL WELL
- ○ OTHER WELLS, B.G.S
- ⊙ OFFSHORE B.G.S WELLS
- ⊗ WELLS AND SPRINGS
- □ CONFIDENTIAL WELL

Km
0 5 10 15 20 25
0 5 10 15
M

COMPILED BY S.D.LAKE 1985

SS 0 ST

ST 0 SU

SS 0 SX

SU 0 SZ

SX 0 SY

SY 0 SZ

Grid N

0

IIA2

LANDSAT MSS lineament map path 216:row 24 path 217:row 24 1:250,000

BAND 7 (0·8-1·10 μm NEAR INFRA RED)

WINTER IMAGERY

MOSAIC COMPILED by G.S.L

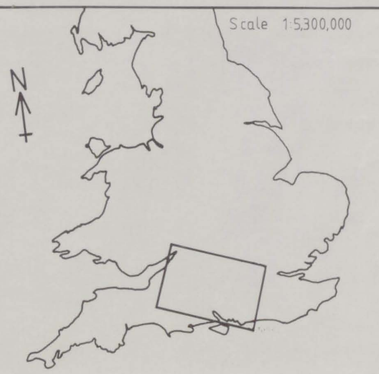
Interpretation by Stuart Lake

DURHAM UNIVERSITY NERC FEB 1984

KEY

- CLEAR LINEAMENTS
- SUBTLE LINEAMENTS
- LIMIT OF CLOUD COVER
- ANTICLINAL AXIS
- SU BURBAN LONDON

Scale 1:5,300,000



Scale

KILOMETERS 0 5 10 15 20 25

MILES 0 5 10 15

GLOUCESTER
OXFORD
READING
SWINDON
BRISTOL
GUILDFORD
SALISBURY
SOUTHAMPTON
YEOVIL
BOURNEMOUTH
WEYMOUTH
N grid

11A3

LANDSAT TM lineament map path 202:row 24 1:250,000

BAND 5 (1·55-1·75 μm NEAR INFRA RED)

IMAGE TAKEN 4-2-83

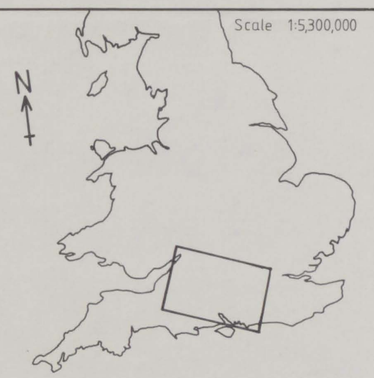
Processed on Diad system by N.P.A

Interpretation by Stuart Lake

DURHAM UNIVERSITY N.E.R.C JAN 1984

KEY

- CLEAR LINEAMENTS
- SUBTLE LINEAMENTS
- ANTICLINAL AXIS
- SU BURBAN LONDON



Scale

KILOMETERS

0 5 10 15 20 25

0 5 10 15

MILES

GLOUCESTER

OXFORD

SWINDON

READING

GUILDFORD

BRISTOL

SALISBURY

SOUTHAMPTON

N grid

11A4

TM LINEAMENT MAP

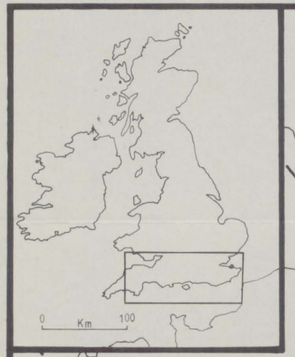
Major lineament related to growth f.

Other lineaments

0 5 10 15 20 25 Km

0 5 10 M

N



HYDROCARBON OCCURENCES IN THE WESSEX BASIN

KEY

- OIL WELL
- GAS WELL
- OIL AND GAS WELL
- SIGNIFICANT OIL AND GAS SHOWS
- ABANDONED DRY WELL
- LOCATION OF WELLBORE IN WYTCH FARM OILFIELD
- OIL SEEPAGE
- GAS SEEPAGE
- SHERWOOD SANDSTONE RESERVOIR
- BRIDPORT S/ST OIL WATER CONTACT
- GREAT OOLITE LIMESTONE RESERVOIR

AG	ARNE G1
B	BUSHEY FARM A12
E	ENCOMBE 1
G1	CHALDON DOWN G1
G2	CHALDON DOWN 2
HR	CHALDON HERRING 1,G2,G3
K	BROAD BENCH 1, KIMMERIDGE 1,2,3
KS	KIMMERIDGE NORTH KS
LHN	LANGTON HERRING NORTH 1
LHS	LANGTON HERRING 1
O 1-2	OSMINGTON 1,2
P	POXWELL 1,2,3
R	RINGSTEAD 1
RA	RADIPOLE 1
S	STOBOROUGH 1,2
W	WAREHAM 1,2,3

1 : 625,000 Scale

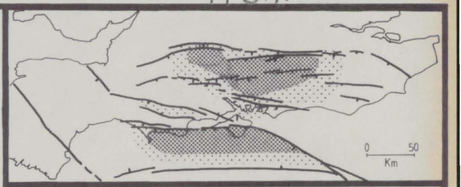
Grid North

Scale 0 10 20 30 M / 0 10 20 30 40 50 Km

WYTCH FARM OIL FIELD

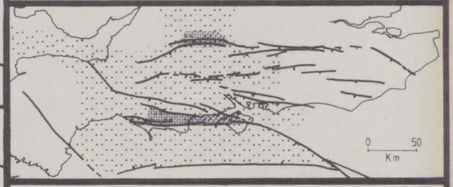
HUMBLY GROVE OIL FIELD

FIG

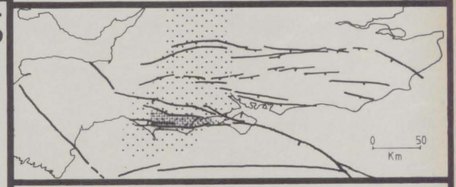


LOWER LIAS Source Mature Early Maturity

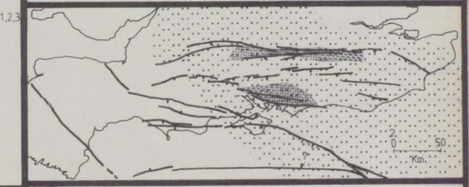
KIMMERIDGE Source Mature Early Maturity



SHERWOOD SANDSTONE Reservoir



BRIDPORT SANDSTONE Reservoir



GREAT OOLITE LIMESTONE FORMATION Reservoir

Reservoirs distribution | Optimum reservoir location

© Stuart Lake Durham University 1-7-85

VOLUME 2

Fig.II.1.1 Western Wessex Basin, Solid Geology map, (1:250,000 scale).

Fig.II.2.1 Previous north-south structural profile across the Wessex Basin, 1:100,000 scale based on data acquired prior to this study.

Fig.II.2.2 Track lines of seismic reflection profiles based on G.S.I. non -exclusive seismic reflection survey and I.G.S. project 76/8 and 77/1 (part) used to compile a structural map of the Top Penarth Group in the English Channel.

Fig.II.2.3 Top Penarth Group structural map of the English Channel. Interpretation by S.D. Lake. Based on G.S.I. non-exclusive seismic survey.

Fig.II.2.4 Composite Bouguer Gravity anomaly map, Wessex Basin, 1:500,000 scale (Redrawn from B.G.S. Sources).

Fig.II.2.5 Two-way time isochron map of dipping reflectors in Lyme Bay and associated active late Palaeozoic/Mesozoic faulting, (1:250,000 scale).

Fig.II.3.1 Pre-Aptian subcrop map, (1:250,000 scale).

Fig.II.3.2 Six serial north-south structural profiles across the Wessex Basin. Scale shown. Compiled from geological maps of the onshore British Isles by Whittaker, 1985.

Fig.II.3.3 Chrono-lithostratigraphic column. Western Wessex Basin, S. England (Permian - Quaternary).

Fig.II.5.1 Location map at 1:250,000 scale. Three insets of Lyme Bay, Bradstock and Kimmeridge at 1:50,000 scale.

Fig.II.5.2 Additional Jurassic localities also visited during research.

Fig.II.5.3 Shear sense indicators (1:250,000 scale). Three insets of Lyme Bay, Burton Bradstock and Kimmeridge at 1:50,000 scale. Dextral and sinistral movements distinguished (frequency also shown).

Fig.II.5.4 Additional Kinematic indicators (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000 scale. The detailed orientation of calcite and pyrite veins and styolites are also shown.

Fig.II.5.5 Structures in the Bridport Sands, East Cliff, Bridport.

Fig.II.5.6 Primary Joints 1:250,000 scale. Three insets of Lyme Bay, Bradstock and Kimmeridge at 1:50,000 scale. (Frequency also shown).

Fig.II.5.7 Secondary and Tertiary Joints (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000. Clay or Calcite infill along joint planes are also distinguished.

Fig.II.5.8 Joints all orientations undefined (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000 scale.

Fig.II.6.1 Hydrocarbon occurences in the Wessex Basin (1:625,000 scale).
Inset 1.Detailed plan of the Wytch Farm Oilfield.
Inset 2. Detailed plan of the Humbly Grove Oilfield.
5 insets 1) Lower Lias Clay source rocks - showing areas of postulated maturity and early maturity.
2) Kimmeridge Clay Source rock - showing areas of postulated maturity and early maturity.
3) Sherwood Sandstone Reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.
4) Bridport Sands reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.
5) Great Oolite Limestone Formation reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.

Fig.II.A.1 Boreholes and wells in the western Wessex Basin, at 1:250,000 Scale (including exploration license blocks).

Fig.II.A.2 Landsat MSS lineament map, path 216: row 24, path 217: row 24 (1:250,000 scale). Band 7 (0.8 - 1.10 m. Near Infra Red) Winter Imagery. Mosaic compiled by G.S.L. (Interpretation by S.D. Lake).

Fig.II.A.3 Landsat TM lineament map, path 202: row 24, 1:250,000 scale. Band 5 (1:55 - 1.75 m Near Infra Red). Image taken 4.2.83. Processed on Dial system by Nigel Press Associates. Interpretation by S.D. Lake.

Fig.II.A.4 TM lineament map, 1:250,000 scale of Dorset. Detail of the structures along the Dorset coast particularly well exemplified.